SOUND PRODUCTION AND OTHER BEHAVIOR OF SOUTHERN RIGHT WHALES, *EUBALENA GLACIALIS*

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ABSTRACT.—In late June and early July, 1971, we recorded underwater sounds from southern right whales in Golfo San José, Argentina. The most common sound, a *belch-like* utterance, averaged 1.4 sec in duration, with most of its energy appearing below 500 Hz. Levels of this strong signal ranged from 172 to 187 dB, re 1 $\mu N/m^2$ at 1 m. The whales also produced two kinds of low-frequency *moans.* Simple *moans* had a narrow band of frequencies (centered at about 160 Hz) without appreciable frequency shifts. Complex *moans* exhibited a wider band width (centered at about 235 Hz), extensive frequency shifts, and overtones. Other sounds were categorized as *pulses,* 0.06-sec bursts extending from 30 to 2100 Hz, and *miscellaneous* sounds, comprising numerous phonations below 1950 Hz that varied in length from 0.3 to 1.3 sec. There was no periodic occurrence of sound production other than that related to the appearance of whales in the recording area at low tide.

When presented underwater playbacks of killer whale sounds, a right whale exhibited a behavior pattern called "spyhopping," but there was no obvious avoidance. An attack by five killer whales on two other right whales ended after 25 min, apparently without serious harm to the right whales. A common behavior of these southern right whales, "headstanding," may be associated with bottom feeding. Patterns of breathing varied considerably depending upon associated activities.

Local citizens reported that right whales appear in Golfo San José and nearby Golfo Nuevo each year in late June. They are most numerous in late August and September, and they disappear in November. We saw several consorting pairs that appeared to be courting, but no copulations and no very young whales.

This report describes the underwater sounds and behavior of southern right whales in Golfo San José, Argentina, in June-July, 1971. A brief summary of some of this work was presented earlier (Cummings et al., 1971).

The right whale is virtually world-wide in distribution (Hershkovitz, 1966). Although three subspecies have been recognized (*australis:* Southern Hemisphere; *glacialis:* North Atlantic; and *japonica:* North Pacific), their validity is questionable (Rice and Scheffer, 1968). In this report we call this cetacean the "southern right whale" with no attempt to evaluate any subspecific rank.

Right whales, so named by whalers because these animals have a high oil content and float when dead, attain a maximum length of 18 m. They may be identified at sea by a characteristic V-shaped blow (Fig. 1A), light-colored horny protuberances on the upper snout which include the bonnet (see Ridewood, 1901, and Matthews, 1938, for detailed descriptions), and by the lack of both a dorsal fin and throat grooves. Compared with other species of great whales, right whales are very rotund (Figs. 1B, 2). Although killing of these animals has been prohibited for many years, the population remains exceedingly small in many regions (Ohsumi et al., 1971; Doi et al., 1971), and the species may be in danger of extinction through overharvesting.

Southern right whales have long been known to breed in bays and other sheltered waters (Scammon, 1874), and recent information indicates the same is true of northern animals (pers. comm. W. E. Schevill, Woods Hole Oceanogr. Inst.). In mid-July, 1969, Gilmore (1969) located 20 to 25 right whales that were courting and presumably mating in Golfo Nuevo, Argentina. On his advice, our attempts to record the vocalizations of this rare cetacean and to observe its behavior were concentrated in this region.

Little is known about vocalizations of the right whale. In discussing this whale's behavior after being harpooned, Scammon (1874) wrote that, "after going a short distance, it frequently stops, or 'brings to,' 'sweeping' as it is said, 'from eye to eye,' and at the same time making a terrific noise called 'bellowing,' this sound is compared to that of a mammoth bull, and adds much to the excitement of the chase and capture." Schevill and Watkins (1962) presented a description and a recording of low-frequency moaning sounds of northern right whales. Cummings and Philippi (1970) reported low-frequency (20-174 Hz)

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pulses and moans tentatively identified as being from northern right whales. These sounds, recorded off Newfoundland in December, 1965, appeared in repetitive, 11-min to 14-min stanzas that were separated by 8 to 10 min. Each stanza was composed of numerous signals appearing in a precise sequence that was repeated in the next stanza. Payne and McVay (1971) described a similar repetitive phenomenon, "songs," from the humpback whale, *Megaptera novaeangliae.*

MATERIAL AND METHODS

This research was largely carried out from the National Science Foundation's research ship, HERO, a 38-m vessel that is managed by the United States Antarctic Research Program. We left Punta Arenas, Chile, on 11 June and proceeded north along the coast as far as Bahía Blanca, Argentina (39°N), returning to Punta Arenas on 16 July. Although other marine mammals were sighted along the coast, we did not see right whales in areas other than Golfo San José, an enclosed bay, 44×20 km, on the north side of the Valdés Peninsula (Fig. 3). There, from 21-24 June and from 1-8 July, we observed about 10 southern right whales, this estimate based on searching the entire Gulf on each of several days.

The deepest area of the Gulf is about 82 m, but most of the whales were observed near shore in less than 37 m. Because the Gulf is protected and shallow, we generally experienced moderate or calm seas of State 2 or less. Air temperatures ranged from 6.1 to 8.3°C. We took bathythermographs in several areas of the Gulf and found isothermal conditions averaging 9.4°C. The ship's small boats occasionally were used for short excursions close to the whales, although we generally kept our distance so as not to intentionally crowd or molest them.

Underwater recordings were made with much the same system described by Calderon and Wenz (1967). Essentially, our recording system consisted of an acceleration-balanced hydrophone, flexible spar buoy, floating cable, calibrating device, sound-level meter, magnetic tape recorder, and monitoring equipment. Instruments used in playing sounds to right whales included a tape recorder (Uher 4200), preamplifier (Bogen BT-35A), high-power amplifier (Optimation PA 250 AC), and an underwater sound projector specially designed by Wesley L. Angeloff of the Naval Undersea Research and Development Center. The frequency response of the playback system was ±5dB from 650 to 3100 Hz, limited by the projector. Response of the receiving system was ±5 dB from 25 to 15000 Hz.

To obtain good recordings of low-frequency mysticete sounds, we have found it best to use a hydrophone that is relatively stationary in the water column and has a good low-frequency response, but not all the way down to 0 Hz. The response must be "rolled-off" in the low frequencies for use under normal sea conditions in order to prevent the reception of low frequency noise. Such a hydrophone is still unsuitable, however, for towing from a moving vessel.

A hydrophone is designed to respond to changing pressure. Pressure changes caused by towing a hydrophone, or those resulting from the vertical excursions so characteristic of moderate or greater sea states, will usually produce excessive low-frequency noise. Coupled with the high sound pressure of low-frequency ambient noise (Wenz, 1962), acceleration and flow noise of this type will easily mask a low-frequency mysticete signal. Experience has taught us that such recordings have very low signal-to-noise ratio. More often, they are rendered useless by intermittent or even continuous blocking of the hydrophone's preamplifier. The dynamic range of response of this preamplifier generally will not accommodate that of the electrical energy from sound pressures imposed on a hydrophone under the above circumstances. The blocking occurs when the preamplifier is overdriven by an input signal that greatly exceeds the maximum input level designed for the amplifier.

To reduce these vertical and horizontal movements, we use an inflatable buoy for flexibility and a 450-m buoyant cable that is let out as fast as the ship drifts. The cable floats by means of a buoyant sheath that is molded around the conductors. In combination with a good-quality hydrophone having low-frequency rolloff and acceleration

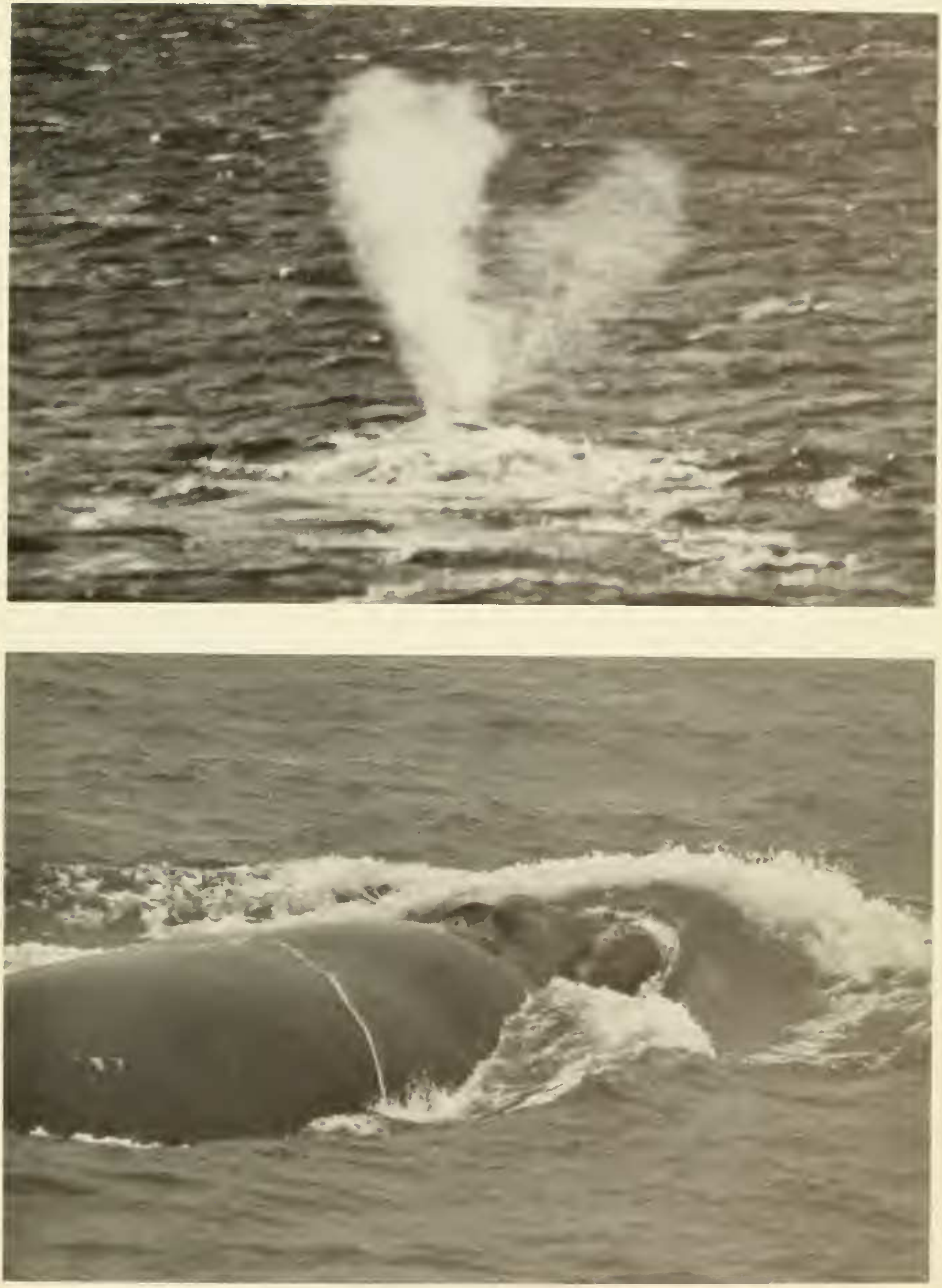

Figure 1. A, V-shaped blow (exhalation) of a southern right whale; B, quartering view.

balancing, this system works well for us most of the time. Other investigators have dealt with the problem in other effective ways (Watkins, 1966).

The right whale sounds were recorded under quiet conditions, with all engines shut off. However, the ship's generator was needed during playback experiments. Most of our recordings were made while the ship was quietly lying to, 0.2 to 1.5 km from the whales. Whenever possible, we kept an account of the whales' behavior during the recordings, both in a written log and as verbal comments on magnetic tape. Recording times of contacts varied from 10 to 120 min, after which the whales either moved out of an area or we simply stopped the recording.

PHONATIONS AND SOUND PLAYBACK

Southern right whales made several different types of powerful, low-frequency sounds resembling belches, moans, and pulses (Fig. 4, A-D). They also produced a number of miscellaneous low-frequency sounds, too numerous to classify.

By far, the most common sound was a *belch-like* utterance that varied from 0.9 to 2.2 sec in duration and averaged 1.4 sec with principal energy centered at 235 Hz. Although the frequency ranged from 30 Hz to about 2200 Hz, the major portion fell below 500 Hz. *Belch-like* sounds often ended in about a 150-Hz upward frequency shift (Fig. 4A).

The first portion of the *belch-like* sound revealed two to four strong overtones with intervals of about 100 Hz. Sound pressure levels of the *belch-like* sounds were 172 to 187 dB, re 1 $\mu N/m^2$ (=72 to 87 dB, re 1 μbar) at 1 m from the source. Source levels were determined from measurements in a band from 25 to 2500 Hz, thus including all frequencies of *belch-like* sounds. These levels were derived from the absolute received sound pressure levels at the hydrophone (as measured in the laboratory from the calibrated recordings) and the estimated distances of the whales from the hydrophone. The calculations took into account an estimated spreading loss of 6 dB per distance doubled. Attenuation losses were regarded as negligible, because the whales were so close and their calls so low in frequency.

Southern right whales also made moaning sounds of several different kinds. Their moans were classified into two basic types, simple and complex (Fig. 4B). Simple *moans* had sound energy that was confined to a relatively narrow band without appreciable shifts in frequency. Simple *moans* lasted from 0.6 to 1.6 sec. The highest frequency noted was 320 Hz, the lowest was 70 Hz, and the region of principal energy was about 160 Hz. Complex *moans* exhibited a wider band of energy, extensive frequency shifts, overtones, and a longer duration compared to simple *moans.* The highest frequency observed among complex *moans* was 1250 Hz, the lowest was 30 Hz, and the region of principal energy was 235 Hz. The duration of complex *moans* ranged from 0.2 to 4.1 sec.

The third most common of the major types of right whale sounds were *pulses* (Fig. 4C). These sounds extended from 20 to 2100 Hz, and lasted only about 0.06 sec. The pulses frequently occurred in conjunction with a *moan.*

The remaining sounds consisted of numerous, *miscellaneous,* low-frequency sounds that varied in length from 0.3 to 1.3 sec (Fig. 4D). All of these were below 1950 Hz.

We were unable to associate sound production with any specific behavior. The sounds emanated from surfacing as well as from diving whales. They came from single whales or from small groups of two to three individuals. Although some of the right whales may have been feeding and others presumably were courting and perhaps mating, we were unable to associate any sounds with a particular activity. In one instance we were in a small rubber boat, close to a surfacing whale, when the whale produced a thunderous, cavernous, bellow between two exhalations. The sound was clearly audible in air and may have been the same type of sound described by Scammon (1874). This whale was one of two that were consorting near us, in very shallow water.

Extensive recordings were made in the southeast corner of Golfo San José to determine if there was any diurnal periodicity in sound production. These recordings were made for 15 min every 2 hrs, beginning at 1830 on 2 July and ending at 1030 on 4 July. We continued to listen for 10 to 20 min after each recording. Most of the right whale sounds on these recordings occurred close to the three low tides (Table 1), a phenomenon that may have been associated with the appearance of right whales in this area and not necessarily with any daily rhythm in sound production. At other times the whales moved along shore, either toward the west or north. There was no indication of a difference in daytime vs nighttime activity in sound production. In this general vicinity we doubt that whale sounds originating more than about 2 km away would have been detected, because of the limited propagation which could be expected in the presence of the coves, shallow water, and disrupted bottom.

Table 1. Occurrence of right whale sounds on nineteen 15-min recordings.

Time of Day	Date	No. of Sounds	Time of Low Tide
1830	2 July	0	
2030	2 July	0	
2230	2 July	4	
0030	3 July	3	
0230	3 July	30	0112
0430	3 July	0	
0630	3 July	3	
0830	3 July	1	
1040	3 July	0	
1245	3 July	28	
1515	3 July	1	1348
1945	3 July	4	
2150	3 July	0	
2345	3 July	10	
0145	4 July	11	
0345	4 July	1	0200
0545	4 July	6	
0830	4 July	0	
1030	4 July	6[1]	

[1]Five of these 6 sounds occurred in 9 sec and appeared to be a series of sounds from a single right whale.

Our earlier experiments had shown that certain marine mammals appeared to recognize underwater sounds of killer whales. Migrating gray whales, *Eschrichtius robustus,* off southern California, avoided underwater playbacks of killer whale "screams," (Cummings and Thompson, 1971); and playbacks prevented white whales, *Delphinapterus leucas,* from swimming up the Kvichak River in Alaska, where young salmon were migrating to the open sea (Fish and Vania, 1971). Thus, playback experiments provide a new source of information about the behavior of whales in their natural environment. For example, the escape reaction of the gray whale to killer whale sounds can be used to test the hearing capabilities of this species. Also, by playing tapes of certain segments of killer whale signals it may be possible to determine which parts of these signals induce an avoidance reaction.

We played back killer whale "screams" to a group of three southern right whales. HERO was 1.8 km from the beach, in 12 m of water, and all of the whales at first were less than 2 km away. The underwater sound was monitored with a hydrophone. We observed the whales for 15 min before playback. The first transmission consisted of 5 min of random noise, as a control. After 2 min of silence we transmitted a 5-min tone (described by Cummings and Thompson, 1971), also as a control. After 3 min of silence we played back 5 min of prerecorded killer whale sounds. Sound pressure levels of the playbacks, measured in situ with a calibrated system, varied from 159 to 163 dB, re 1 $\mu N/m^2$ at 1 m from the source. Generator noise from the ship measured 134 dB, over the effective bandwidth of the recording system, at the same location and time of the playback experiments.

Only one whale could be seen well enough to observe its reaction. For 15 min before, it had been moving slowly back and forth along the beach, blowing at irregular intervals. There was no obvious change in its behavior when confronted with either the random noise or the tone. When the killer whale "screams" were played back, the right whale appeared to behave as before, except that it frequently raised its head out of the water in a "spyhopping" posture. This behavior consisted of raising the head vertically out of the water with the eyes above the surface. In earlier experiments, Cummings and Thompson (1971) found that gray whales fled a sound source for an appreciable distance and then "spyhopped." They concluded, as did Gilmore (1958), that "spyhopping" was an investigative behavior.

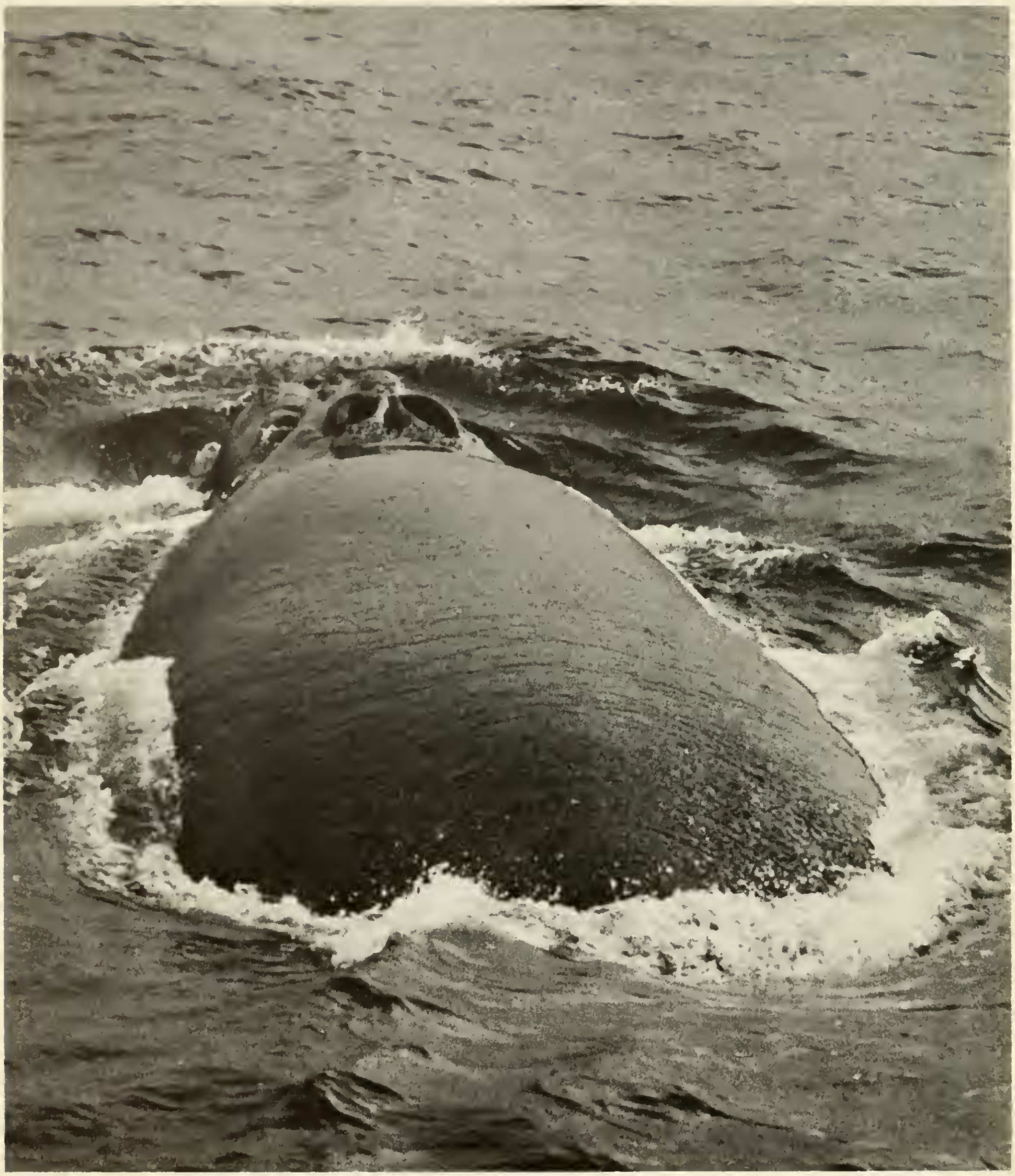

Figure 2. Dorsal view of a southern right whale heading away from the ship. Note the widely separated blow holes and the rotund form of this species.

OTHER BEHAVIOR

On 4 July, in order to make detailed photographs, we accompanied a pair of right whales that apparently had been courting. We had just finished our work at dusk, and they had resumed their rolling antics near the surface, when a group of killer whales appeared off HERO's stern. The killer whales were heading away from the right whales; then, suddenly, they whirled around and swam straight towards the two right whales which were separated by about 45 m.

When the killer whales were about 70 m away, the right whales came together so closely that they appeared to be touching one another. As soon as the killer whales had reached them, the right whales started slashing the water's surface with their flukes and flippers. The right whales were then blowing every 10 to 20 sec, twisting and turning in

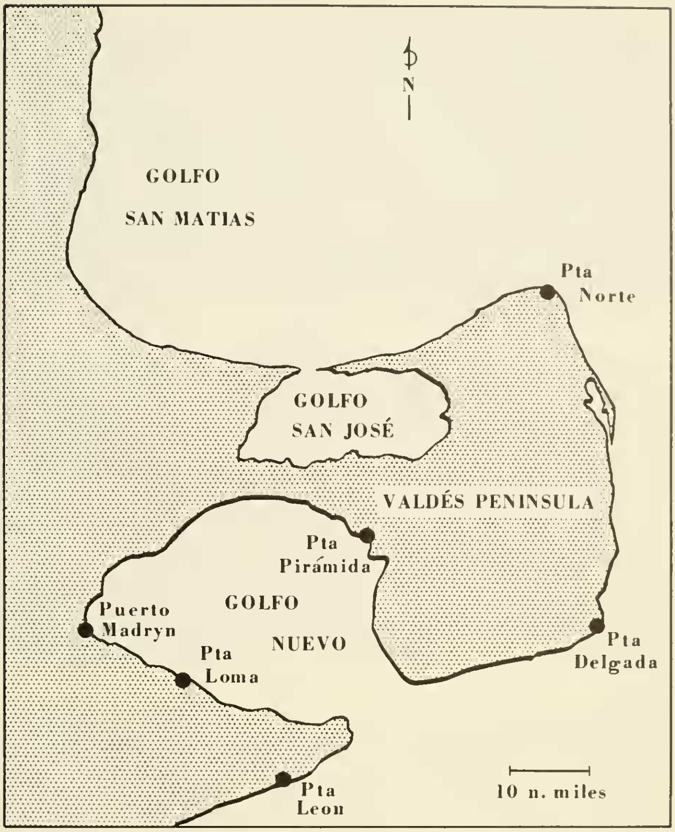

Figure 3. Chart showing the Valdés Peninsula of Argentina.

the water as the killer whales swam around them.

We were too far away to see whether or not the killer whales were actually biting the right whales. However, in other respects it appeared to be a full-fledged attack. On at least three occasions, one or the other right whale was on its back, thrashing the water's surface with its flippers and flukes at the same time. At one point, the right whales were completely encircled by the killer whales. The most impressive of the large whales' defensive maneuvers was the way they kept together—rolling, turning, and slashing within such close quarters. In at least two instances, the attacked and the attackers all were below the surface with nothing showing but a slick of whirling water.

We moved to within 0.5 km to record any underwater sounds at short range. However, when the ship had stopped, and we had only been recording for a short time, the killer whales left their prey and swam toward the ship. We counted five killer whales, including one very young animal and apparently four females. The attack had lasted 25 min, and occurred in 30 m of water.

The right whales then moved into very shallow water (7-11 m) where they rolled at the surface, more slowly than before the attack, exhibiting a notable decrease in activity. There were no signs of blood or other evidence of physical harm in the vicinity of the attack.

We recorded for about 3 min before the attack ended and for 15 min afterward, but obtained no underwater sounds from either species, even though both were well within range of the hydrophone. Gray whales and white whales became significantly quieter when confronted with killer whale sounds (Cummings and Thompson, 1971; Fish and Vania, 1971). Nevertheless, even in a recording as short as ours, we expected some phonations from the loquacious killer whales or the right whales. However, under these circum-

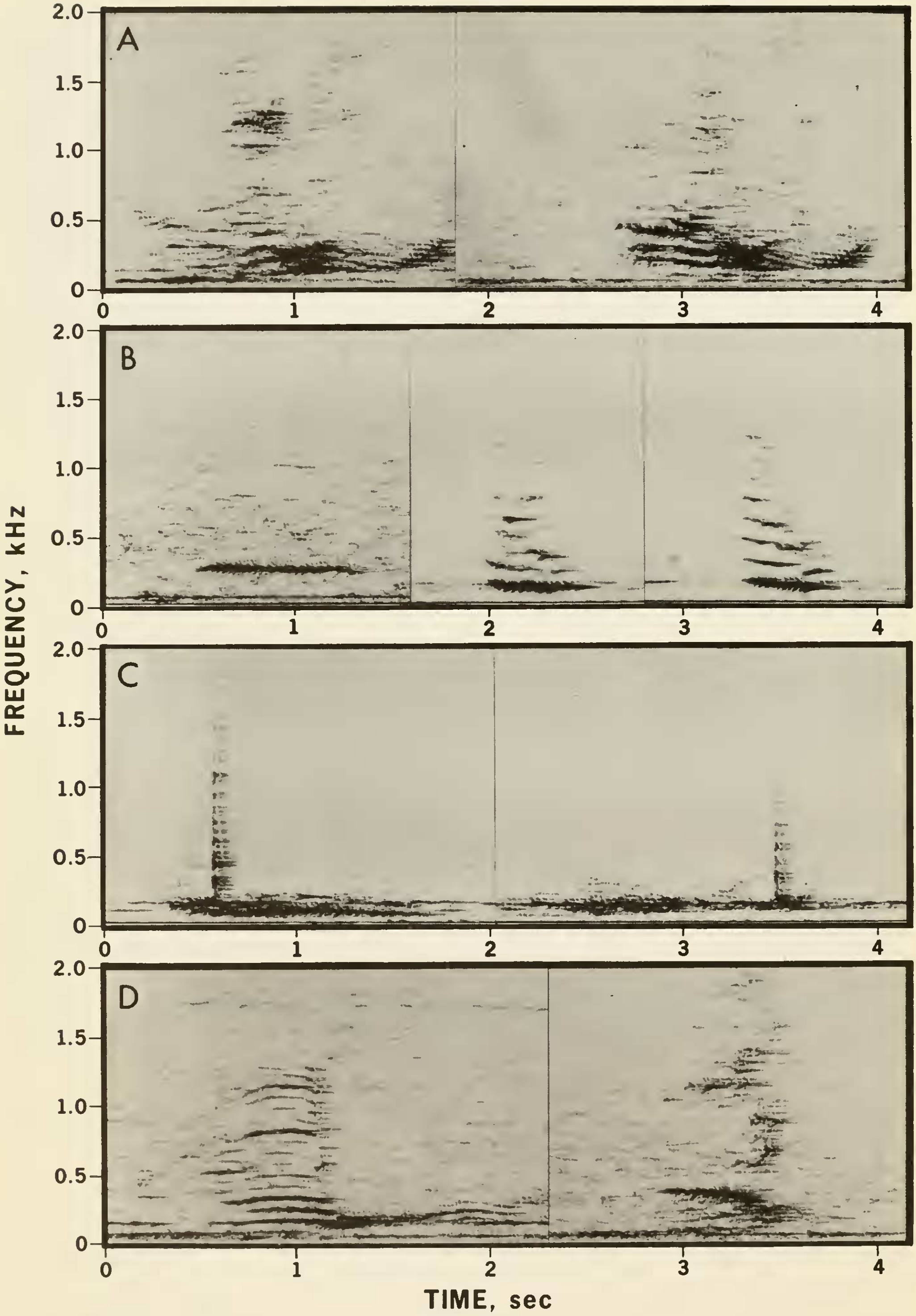

Figure 4. Sonagrams of sounds from southern right whales recorded in Golfo San José, Argentina. Row A, two *belch-like* sounds; Row B, one simple and two complex *moans;* Row C, *pulses* associated with simple *moans;* Row D, two examples of *miscellaneous* sounds. The effective bandwidth of the analyzing filter for these sonagrams was 10 Hz.

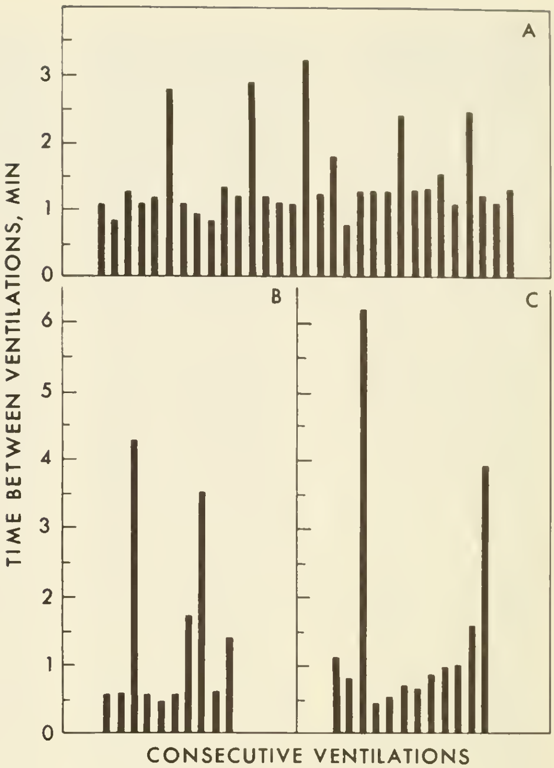

Figure 5. Histogram showing the time duration between consecutive ventilations of the southern right whale. Conditions A, B, and C explained in text.

stances neither may have profited from being noisy (see Schevill, 1964).

We saw killer whales on two other occasions in Golfo San José—a group of three on 1 July, in the mid Gulf, and another group, of six, on 8 July, near the east end. Evidently, these animals are common near Valdés Peninsula as several observers reported seeing them inside and outside of the two gulfs.

Two mussel fishermen, Jorge Enrique Ramirez and Jorge Raul Terenzi, related to us that their Captains, Roque Godio and Calixto Gerez, had also witnessed attacks of killer whales on right whales near the Valdés Peninsula. In one such attack they related that five killer whales "hammered" away at the head region until the right whale opened its mouth. The killer whales then started tearing away at the tongue. The area was colored with blood, the killer whales left, and the right whale was lying motionless at the surface, apparently dead.

Apparent pairs of right whales were seen on several occasions. They spent much time rolling at the water's surface, exposing bellies, backs, flukes and flippers, and occasionally "spyhopping." Members of a pair were often very close to each other, and at times they appeared to be in physical contact. Some of this behavior may have been associated with courtship, but we obtained no evidence of actual mating. Since we could not recognize individual whales, we could not determine if the association was prolonged for more than about half a day.

The "headstanding" posture consisted of holding the flukes upright and out of the water for periods up to 2 min. During this time, the flukes slowly rocked back and forth or from side to side, occasionally arching downward toward the water's surface. "Headstands" only occurred in very shallow depths, and the behavior was more frequent among single whales.

Right whales appeared to have little fear of the ship or the rubber boats. We once ventured as close as 9 m with a rubber boat, and neither one of a consorting pair showed any apprehension. Other observers have had the same experience (Matthews, 1938). Moreover, the two fishermen who were interviewed reported that they once were awakened at night by a right whale rubbing its head on the side of their boat.

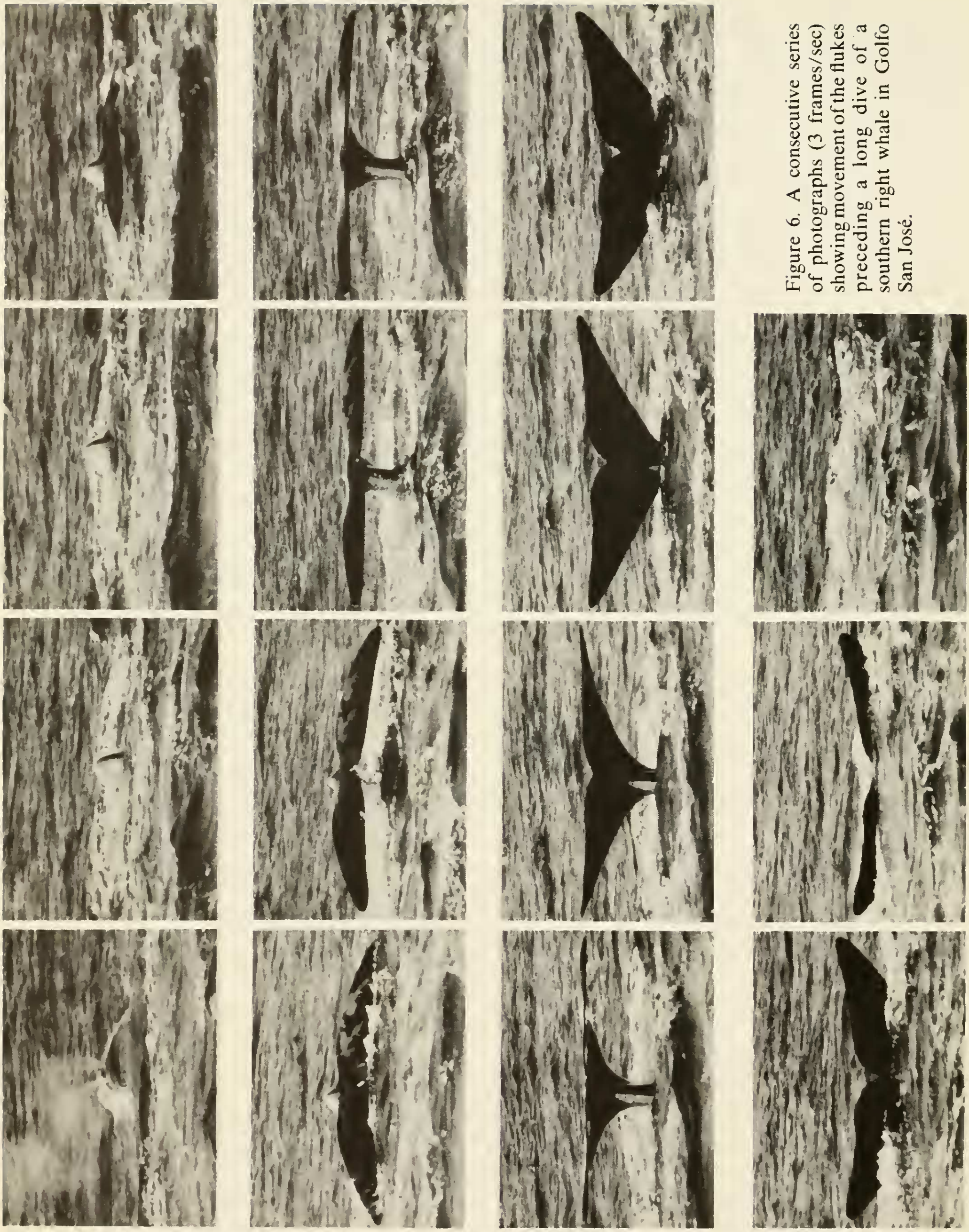

Figure 6. A consecutive series of photographs (3 frames/sec) showing movement of the flukes preceding a long dive of a southern right whale in Golfo San José.

Occasionally, kelp gulls, *Larus dominicanus,* and brown-headed gulls, *L. maculipennis,* landed and rode on whales at the surface. One gull that landed near the blowhole was blown off by the next expiration. The gulls actually pecked at the whales, and possibly were feeding on parasites.

The whales we studied were rather sluggish. Many swam very slowly at the surface for long distances—in one case about 4 km without diving. Apparently, the whales were incapable of speeds greater than about 14.8 km/hr (8 knots). HERO's top speed of 18.5 km/hr (10 knots) easily enabled us to overtake two whales, whereas at 14.8 km/hr the ship could only keep up with them. The two that we accompanied tired more quickly than other mysticete whales we have studied.

The whales' respiratory rate depended upon their activity. Whales swimming slowly at the surface ventilated about once a minute, or once every 2 to 3 min when performing "headstands" in the interim (Fig. 5A). A whale encountered in deeper water as it swam fairly rapidly and directly towards shore breathed irregularly, diving for periods that varied between 0.5 and 4.3 min (Fig. 5B). A whale we had been following stayed down for 6.2 min (Fig. 5C), and at another time its longest dive was 8 min.

Transiting right whales (those that moved along on a direct course without spending much time at the surface) usually displayed their flukes just before an extensive dive (Fig. 6). However, the next to last surfacing was sometimes accompanied by "false fluking," the flukes being drawn up close to but not above the surface.

Our brief stay in Golfo San José did not permit long-term observations of southern right whales, but the following information was obtained from local observers, particularly Santiago Ortega, Perez Macchi, and Carlos Oscar García:

1. Southern right whales occur in Golfo San José and nearby Golfo Nuevo each year. The whales come from the south and begin to show up at Golfo San José in late June, before they appear in Golfo Nuevo. They are most numerous in late August and September. Fewer are present in October, and all disappear during November.

2. The total number of right whales in the Valdés region is unknown, mainly because there is replacement, with some arriving and some departing throughout the season. Up to 30 may be seen at one time in Golfo San José during the peak of the season, and others can be found out to sea, just east of the peninsula. The reporters knew of no other place along the Argentine coast where this species enters bays each year.

3. All observers thought that right whales court and copulate in the two gulfs, but none thought that the young were born there. Small whales, seen in these gulfs, were judged too large to have been born there during a current "whale season."

4. Right whales reportedly have become more numerous in this area in recent years, as is true of elephant seals and sea lions of the region, possibly because the Valdés Peninsula has become a wildlife refuge for land and sea animals. It is illegal to kill marine mammals in either gulf and the area is heavily patrolled.

DISCUSSION

We have recorded underwater sounds from six of the ten species of mysticete whales, and all the sounds have been low-frequency utterances below 3000 Hz. Although there are a few reports of high-frequency phonations in the presence of mysticetes (Perkins, 1966; Poulter, 1968; Beamish and Mitchell, 1971), baleen and toothed whales are markedly different in that low frequency is more typical of the former and high frequency of the latter. A good single hydrophone can yield an acceptable recording of these strong low-frequency signals, when used in calm seas and not towed through the water .

(The single, omnidirectional hydrophone may eventually be replaced by an effective line array of several transducers that could be towed from a drifting or sailing ship. In theory, the advantage of a line array comes from increased signal-to-noise ratio accomplished through directivity toward the sound source. The means for attaining such directivity generally involves proper spacing of the individual hydrophones to phase out the input from directions other than those that are normal to the array's conformation. The extent of spacing is related to the wavelength involved and thus would be considerable in the case of low-frequency mysticete sounds where wavelengths are as long as 120 m or more. A 5-hydrophone array for this frequency would approximate 300 m in length. Unfortunately, present systems such as this are burdensome to use, and they involve complex signal processing. Moreover, the line array is not within the budget of most scientific investigations, nor is one yet available that is relatively noise-free with a high enough response across the entire frequency range of mysticete sounds.)

The *belch-like* sounds and complex *moans* of southern right whales reported here resemble some of the sounds of northern right whales presented by Schevill and Watkins (1962). However, we also found dissimilarities. Differences in behavior, in addition to possible regional differences resulting from evolutionary divergence, could account for such a disparity. Furthermore, our recordings had no evidence of repetitive stanzas that Cummings and Philippi (1970) suggested were from northern right whales. Their recordings were made in the open, deep sea, far from land in an area of the North Atlantic where breeding of northern right whales is unknown. The present recordings were made near shore in a protected, shallow embayment, where whales were courting.

Our earlier sound playback experiments were so successful in producing avoidances by gray whales and white whales that we expected the right whales to behave similarly, especially as they occur in an area where killer whales are known to attack them. Perhaps other playback attempts would produce a more decisive reaction. The source level of the sounds played was less than that used in experiments with gray whales and white whales. Also, the right whales were an appreciable distance from the ship, in very shallow water where we would not expect good propagation. Possibly the playback was not very audible to the whales in this location.

Right whales exhibited the "headstanding" posture mostly in the southeast corner of Golfo San José, in an area reported by fishermen to have dense populations of mussels. Local fishermen believe that this behavior is associated with feeding on mussels, and we support this idea. We observed the whales in water that was shallow enough to allow their heads to touch bottom and their tails to be exposed. In two instances of "headstanding," at a location where the water was only 6 to 8 m deep, the whales either had to be in contact with the bottom or had to arch their whole bodies. It is doubtful that they could have held their tails out of the water for such a long time, with the remainder of the body bent away from the bottom. Moreover, we did not observe "headstanding" in places known to be deeper than the estimated length of the whales. Right whales are positively buoyant, but holding their tails above the surface may make them just heavy enough in water to keep their heads against the bottom.

The idea of mysticetes feeding on mussels is not without precedent. Scammon (1874) reported that gray whales fed on mussels, based upon his having observed the mussels in the whales' "maws." In fact, he included the term "Mussel-digger" in his list of vernacular names for the gray whale.

The Valdés Peninsula area is well suited for studies of marine mammals. In addition to southern right whales and killer whales in Golfo San José, we observed southern sea lions (*Otaria flavescens*), elephant seals (*Mirounga leonina*), bottlenose porpoises (*Tursiops truncatus*), "white-sided" porpoises (*Lagenorhynchus* sp.), and common porpoises (*Delphinus* sp.). To the south, large numbers of sea lions haul out at points Leon, Loma, Pirámida, and Delgada (Fig. 3). There were about 800 sea lions at Punta Pirámida at the time of our visit, and we were told this number would increase to 3000 in December. Natural parks with facilities for visitors have been established at Punta Loma and Punta Pirámida. Some elephant seals occurred with the sea lions at Punta Leon. From our interviews, we learned that elephant seals are most numerous from September to December, especially at Punta Norte. It was in this area, in 1969, that Dr. Raymond M. Gilmore saw 150-200 elephant seals as early as 13 July (pers. comm.). The seals were in three scattered groups, some of them occurring with sea lions.

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